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FUEL LINE

January-March 1984

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The effects of oil supply on military readiness

DFSC

Fuel Line

A DEFENSE FUEL SUPPLY CENTER TECHNICAL PUBLICATION

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January-March 1984

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The Effects of Oil Supply on Military Readiness

by Lt Col TERRY J. ARNHOLT, USAF

The Oil Crises

An Arab Oil embargo of 1973 precipitated an oil crisis, but by the time the Iranian revolution of 1979 was over conservation was in full swing. The conservation ethic coupled with a worldwide recession dampened the thirst for oil, and by March 1983, OPEC was selling only 14 million barrels of crude oil per day, whereas in 1977, they marketed over 31 million barrels daily. As the non-Arabian Peninsula OPEC members sank into debt, they began to discount their oil. Conoco Inc. estimated that by March 1983, 45 percent of the internationally traded crude oil was sold at a discount from the official price. The force of these events caused the OPEC ministers to agree to cut their price by $5 per barrel and to set a production ceiling of 17.5 million barrels per day. Saudi Arabia agreed to be the "swing producer," varying its output to keep OPEC oil supply in step with demand.

By 19 April, oil industry sources generally agreed that OPEC's strict adherence to its price and production pact had brought a significant degree of stability back to the oil market. However, most experts felt that any firm judgment of OPEC's success in steadying oil prices would be impossible before July 1983.

World Petroleum Energy

The "Doomsday Briefing" which circulated in the DOD petroleum community during the late 1970s asserted that it was necessary to increase our energy consumption in order to maintain a growing Gross National Product (GNP). By positing that there was a finite amount of crude oil in the world and that worldwide petroleum consumption would continue to grow at the rate of 6.2 percent per year as it had since 1920, the briefing showed that by the year 2000 the world would be completely out of oil.

Two of the three assumptions, an increase of consumption by 6.2 percent a year and the relationship of a growing GNP to increased fuel consumption, now seem to be disproved. The price of petroleum has stimulated significant conservation, and the change from a smokestack economy to one based on computers has shown that much less energy is needed to generate the same amount of dollars. Today many oil economists project an annual increase of consumption at less than 1 percent. At that rate, the world won't run out of fuel until late in the 21st century.

However, the distribution of crude oil in the world is not equal. Western Europe has very little and Japan has virtually none. Over 50 percent of the known reserves in the world are located around the Arabian Gulf. Beyond 1990, many of the non-OPEC areas will approach productive maturity and begin to decline in production thus adding to the importance of Arabian Gulf suppliers. No matter what is done to develop alternatives by the year 2000, the most important energy sources will still be gas, oil, and coal.

The best hope that the oil importing nations have is that the requirements for revenue among certain OPEC countries will be so intense that they will either reject the idea of production quotas or undercut the established OPEC market. Through the 1980s, the outlook for the importing countries is reassuring, but after that the crude oil market is less certain because of the maturity of the non-OPEC producers' fields and their consequent inability to increase production. Since 84 percent of the spare capacity in oil production is lodged in the Arabian Gulf, an increased oil demand will have to be filled from Middle Eastern oil.

The oil importing countries must continue to reduce the percentage of oil they use in their total energy mix by developing alternatives such as nuclear or synthetic fuels. Otherwise, the Arab members of OPEC will again control price and availability in a fashion that allows them to disregard economic reality. The energy problem is not to prevent the increase of fuel prices but to meet the rising economic cost of fuel with policies that minimize the burdens, allocate them equitably, prevent disruptions in the economy, and keep the cost from rising more than necessary.

U.S. Crude Oil Imports

Oil imports are the critical connection between energy in this country and the rest of the world. A reduction in the amount of oil imported to the United States basically does two things: it reduces the inflationary pressures on the dollar and it reduces the demand for and, therefore, the price of oil on the world market. To date, most of the reduction of imports has been due to conservation but the production of more oil in the United States or the use of synthetic fuels will have the same effect.

William W. Wade, Manager of Economics for Dames & Moore, an engineering consulting firm, has said that oil discoveries in Alaska could reduce U.S. imports to less than 2 million barrels a day by the end of the decade. The National Petroleum Council estimates that 45 billion barrels of oil reserves may be discovered in Alaska, but Congress has limited exploration to 125 million of Alaska's 375 million acres, and because of climatic conditions, a single well can cost as much as $20 million. Actual oil production in the United States has remained fairly static for the past 10 years despite an increase in the number of wells completed. It appears that most of the remaining crude oil is either in small pools or is not readily accessible especially in such areas as the Arctic. If the possibilities of crude production are limited in the United States, what about synthetic crudes?

"During the good times, Joseph advised the Pharoah to store up for the coming hard times."

Synthetic Fuels

While approximately one-third of the potential energy of the entire world is in the United States, only 10 percent of that is in the form of crude oil. Coal, shale oil, and tar sands compose the balance, but the economics of commercial production of fuels from these sources has proven to be elusive. No matter what the price of crude oil has been, synthetic fuel always seems to cost a bit more.

A five company consortium that is building a commercial-size facility for converting coal into substitute natural gas faces losses in excess of $770 million despite its initial expectation of earning a net profit of $1.2 billion in the first 10 years of operation. The consortium had planned to recover its entire outlay in the first nine years of operation, but new projections call for the year 2000.

The Reagan administration has apparently reversed itself on its earlier stand of not supplying government support for synfuels. The government-sponsored Synthetic Fuels Corporation (SFC) expects to offer financial packages to six oil shale and coal gasification projects in the near future. Edward E. Noble, head of the SFC, has noted that although there is a glut of oil on the market, we must show the rest of the world that we can exploit the resources that account for 90 percent of America's energy reserves.

Standard Oil Company of California noted in their June 1982 "World Energy Outlook" that the delay in developing a viable synthetic fuels industry is a concern to all nations dependent on imported oil. Ironically, these nations benefit from the very factor that has caused the delay—lower oil prices. A sudden significant decrease in world oil supplies could force oil prices well above the level needed for economic justification of synthetic fuels plants, but the long lead time necessary for construction of these plants would sustain high oil prices for years.

The rising price of crude oil could also have some very deleterious effects on Third World countries. Some of these countries are barely able to stay afloat financially at current crude prices and another sizable increase could easily force them into bankruptcy. Destabilization and prolonged depression and stagnation of their economies could create a fertile climate for guerrilla war and revolution. While synthetic fuels plants probably can't be justified on an economic basis, they may serve as an insurance policy against supply interruptions and international chaos. It may be to our benefit to use synthetic fuels to help maintain worldwide crude oil prices that are justified by economic factors rather than the desires of the OPEC ministers.

> *". . . the briefing showed that by the year 2000, the world would be completely out of oil."*

Fuel for the Military

For the military, the big question concerning energy is whether there will be enough fuel to fight a major war should it occur in the last fifth of the century. Perhaps the best way to answer that is to look at peacetime statistics and then apply a multiplier for full mobilization.

In fiscal year 1981, the U.S. Air Force (USAF) used a total of 95 million barrels of petroleum. This represented approximately 77 percent of all energy sources used by the USAF, the balance being in the form of gas, electricity, coal, and purchased steam.

The following figures are one way of sizing the military fuel consumption problem:

- Aircraft operations consume 90 percent of all the petroleum that the USAF uses.
- The USAF consumes approximately 55 percent of all the petroleum products consumed by DoD.
- DoD uses approximately 2 percent of all the petroleum consumed in the United States.

By fiscal year 2000 the USAF requirements for petroleum will be approximately 113 million barrels per year. Assuming a peacetime scenario, the USAF should have the energy it needs to ensure operational readiness, but the availability of mobility fuel during an energy emergency is of great concern. In periods of mobilization or wartime, defense energy requirements could triple.

War, perhaps precipitated by the disruption of crude oil supplies, is what the military is paid to manage. However, to fight a war we must ensure that we have adequate portable hydrocarbon energy sources and that will not be cheap.

Henry M. Schuler, Director of Energy Programs at Georgetown University's Center for Strategic and International Studies said, "To relax and think our problems are solved is a tragic mistake that will cause a military confrontation over oil supplies." Because the United States still meets about 40 percent of its total energy needs with oil, of which 25 percent is imported, Mr. Schuler and others in academia advocate national energy planning that would encourage production of synthetic fuels.

Recommendations

In some ways the energy problem is almost biblical: seven years of hard/lean times followed by seven years of good/fat times. If we are to successfully manage the situation, we must remember that during the good times Joseph advised the Pharoah to store up for the coming hard times. There are ways that we can prepare for the hard energy times that may come no matter what we do and are sure to come if we go back to our profligate ways and don't take the necessary steps to ensure adequate energy availability.

- The U. S. government should continue to subsidize the synthetic fuels industry and encourage the building of commercial size plants. While it is true that these plants aren't currently cost-effective and there will very likely be enough crude to meet world requirements in the immediate future, a demonstration of our ability to exploit our oil shale, tar sands, and coal will be both a psychological and economic barrier for OPEC to hurdle should the present crude oil glut become a shortage that prompts OPEC to increase the price well beyond economic justification.

- The Strategic Petroleum Reserve (SPR) should be filled at a faster rate. Congress has approved 750 million barrels by 1985, but at the present rate of fill, it will be late 1991 before that level is reached. At the current import rate of approximately 3.5 million barrels per day, if all imports were cut

off we could continue business as usual for over seven months if we had 750 million barrels in the SPR. In military terms, we could support the USAF wartime mission for more than 2½ years or the normal peacetime mission for almost eight years. This flexibility will cause any nation or group of nations to think twice before embargoing crude cargoes to the United States.

- The military should fund research and commercial development of synthetic fuels. Current national policies leave future availability of fuel for military operations entirely dependent upon civilian efforts. This could be a very serious logistical constraint were a war to be precipitated after a long supply disruption.

- The U.S. government should open more government-owned land to exploration. The environmental impact of exploration is very small and well worth the knowledge that we would gain. Without firm geological knowledge of the reserves in Alaska, our strategic planners are working in the dark.

The opening of government land to exploration will not cost anything other than the wrath of certain environmentalists. The building of synfuels plants will be expensive, perhaps as much as $15 billion over the next 15 years, but the insurance that they would provide can't be overemphasized. The filling of the SPR is also expensive but necessary if we are to meet unexpected supply interruptions with minimal inconvenience.

We must plan and spend now to prevent serious problems in the future. The energy problem is really a management problem and we, like Joseph, must manage it aggressively in the fat years or pay very dearly in the lean ones. **FL**

LT COL TERRY J. ARNHOLT, previously the Chief of DFSC's Stock Control Division, is now the Commander of Air Force Detachment 29.

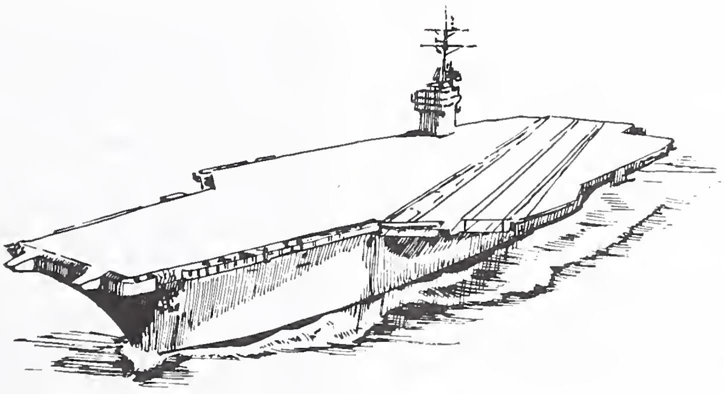
Shipyards Find Chemical Cleaning Versatile, Safe, Thorough

The Navy has been experimenting with a citric acid solution to remove rust from ship tanks and bilges in preparation for surface coating (preservation) with epoxy paints. Chemical removal of scale and iron rust is more thorough than sandblasting. Shipyard workers report that ship spaces cleaned with citric acid require considerably less cleaning and painting during the next overhaul.

The Navy Civil Engineering Laboratory (NCEL), Port Hueneme, has further developed the application of the evolving citric acid process by designing and fabricating a self-contained modular system to clean and protect fuel, water, and ballast tanks, along with bilges, shaft alleys, and voids. This system gives the Navy its first operational capability to independently clean critical shipboard surfaces with citric acid in preparation for recoating.

Operational tests are scheduled for Puget Sound Naval Shipboard Tank and Bilge Chemical and Processing System (STABCHAPS). The portable package consists of (1) a tank module to prepare, heat, and circulate chemical solutions; (2) a pump module to transfer solutions aboard ship to the tanks and spaces at two pressure levels — 100 and 2,000 psi; (3) a vacuum module to remove solutions from decks of tanks and spaces with hoses similar to a household vacuum; and (4) a filter module to separate unwanted solids (paint chips, rust flakes, sand) and to recycle the filtered solution back into the system through the tank module for reheating and recycling. The total package can be accommodated with a 400-square-foot work area. It can be transported to various work locations such as dry docks, piers, barges, and hangar decks of aircraft carriers. The system's flexibility enables it to perform any combination of phases in the citric cleaning process.

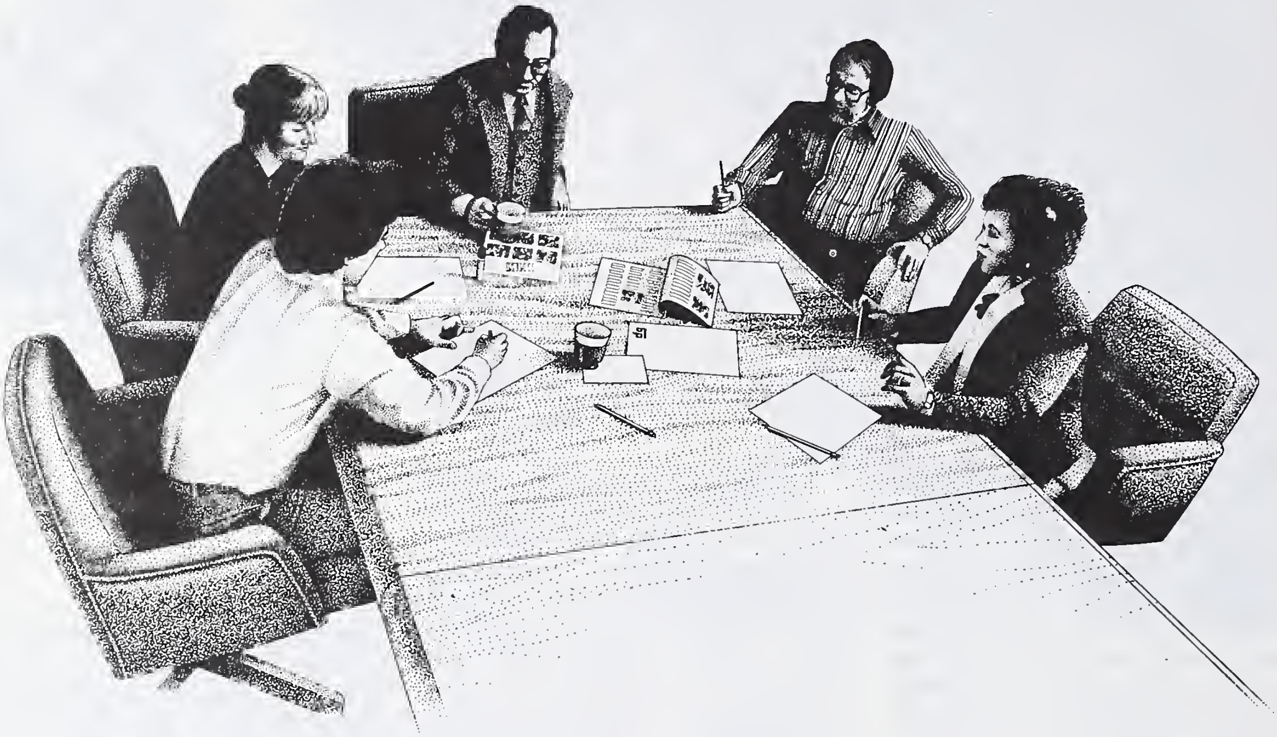
There are several advantages of the citric acid procedure over conventional hand, mechanical, and sandblasting techniques. Although sandblasting provides an adequate surface, it produces a large amount of solid waste. For example, Long Beach Naval Shipyard's three drydocks were accumulating up to 9,000 tons of solid waste annually. Disposal presented a special problem in light of stringent governmental regulations concerning hazardous wastes.



One of the prime advantages of STABCHAPS is its automated spraying system that automatically cleans and derusts tanks. A series of 12 to 18 nozzles, spraying citric acid at 160°F, will clean the rust off the four bulkheads, beams, and overhead in about 2 hours. In contrast, workers need about 12 hours to clean an average tank with hand-held spray devices.

STABCHAPS is so versatile that it can even clean and derust the peaking tank, the most inaccessible space in an aircraft carrier. This capability, in fact, was a primary goal of the system. Also, citric acid spraying removes metal oxides without damaging sensitive machine parts and without generating large volumes of waste. The hot, mild acid solution is recirculated through the tanks, dissolving the surface rust, and subsequently is transferred into dockside waste tanks for reclamation. It is safe to handle, being especially low in toxicity; it reeks no harsh vapors and has low corrosivity toward bare metal.

Navy shipyards are releasing ships from drydocks in better states of preservation than ever. **FL**



At DFSC, quality circles are proving their worth. As problems are identified and solutions devised, workers derive an understanding of management's problems as well as a sense of satisfaction in seeing their contributions utilized.

Six circles are currently operating at DFSC, including those in the Office of the Comptroller, the Office of Telecommunications and Information Systems, the Directorate of Contracting and Production, the Directorate of Supply Operations and the Office of Planning and Management. The major benefits of the Quality Circle Program have been improved morale and communication, but it has also implemented proposals that will result in savings of more than $75,000 per year. Circle members have focused on

> *"Contrary to the initial belief of skeptics that quality circles can only work in industrial settings, circle members have identified and solved a number of problems."*

improving operational procedures and eliminating outmoded practices.

Contrary to the initial belief of skeptics that quality circles can work only in industrial settings, circle members have identified and solved a variety of problems. By focusing on goals established by management, quality circle members identify impediments to the attainment of those goals and then, though brainstorming, devise solutions.

The Lightning Circle, one of the first to be established at DFSC, has initiated six projects in less than a year. Located in the Ground Fuels Division of the Directorate of Contracting and Production, the group has brought about significant improvements in contract certification clauses and reductions of mailing costs with savings estimated at $21,000 per year.

Another of DFSC's original circles, now temporarily disbanded, has been equally busy. "Quality Connections" has made six presentations to management focusing on problems associated with computer products received and tanker orders reviewed by the Accounting Branch of the Office of the Comptroller. The implementation of their suggestions has resulted in actual savings of $14,000.

The work of the "DFSC Telecommunications, Information and Technical Services" circle has led to the implementation of several new procedures. The circle's solutions to the loss and delay of computer output products and the inadequacy of telephone arrangements have resulted in savings of approximately $40,000.

The "Ciphering Ring," located in the Office of the Comptroller, identified several problems only a few months after it was formed. The circle members have written desk procedures for various jobs associated with the special projects function of the Accounting Branch, instituted a buddy system to avoid delays in processing documents, and established an arrangement for maintaining contract files.

One of the newest circles, "Lots Better," located in the Management Control Division of the Office of Planning and Management, has been working on a test project in order to practice the techniques of problem solving. The group expects to begin work on an actual problem soon.

The "Traffic-teers," one of DFSC's newer circles, consists of employees from the Transportation Division of the Directorate of Supply Operations. Several meetings have been held and circles are being formed in the Inventory Management Division of the Directorate of Supply Operations and the Services Division of the Directorate of Contracting and Production.

A side benefit of the quality circle program has been the improvement of morale and the increased communication among various levels of personnel. As circle members work on a problem, they draw other employees into the process thus fostering a greater spirit of cooperation.

A steering committee monitors DFSC circle activities and resolves any interference or conflicts that occur. In order for the concept to work, management must support quality circle activity. The committee is attentive to and addresses indications of management resistance such as long review periods for circle suggestions or consistently negative replies. However, such instances have been practically nonexistent.

The success of DFSC's program is attributed to the commitment and enthusiasm of the quality circle facilitators, leaders, and circle members. DFSC began its program more than a year ago with a plan that was phased to allow for learning and growth. The need for interpersonal management skills was recognized, so the first few steps involved training the persons who would serve as leaders in the program. Then three offices whose work would lend itself to the quality circle concept were chosen to form circles for the pilot program. Before starting to work on actual problems, circle members, who are always volunteers, were trained by their leaders in problem-solving techniques. After that, the success of these circles was all that was needed to induce others to be formed.

In order for quality circles to work, there must be a commitment to the idea that employees can and will contribute to the work-improvement process if they are provided the opportunity, training, leadership, and support. At DFSC that commitment is very much in evidence. As DFSC's quality circle program continues to grow, the organization is sure to benefit from the exchange of ideas and enhanced communication. **FL**

Getting What You Pay For

by LTC Timothy W. Lewis, USA

While working as a petroleum quality assurance representative (PQAR) overseas a few years ago, I witnessed mistakes that cost the government and petroleum refiners large sums of money. Many of these mistakes could have been avoided had PQAR personnel been experienced in performing petroleum quality assurance (QA) tasks. Experienced QA personnel, of course, are not always available for such assignments, so emphasis should be placed on QA schooling and on-the-job experience.

Personnel selected for PQAR assignments should, as a minimum, have completed the PQAR course at Fort Lee, VA, and have been provided the opportunity to work with an experienced PQAR in loading a tanker or two before having to assume that responsibility alone.

The PQAR's task can roughly be divided into three phases—preloading planning, loading actions, and postloading actions. There are many tasks associated with each phase and costly mistakes can—and often do—occur in any one or all the phases.

Before a tanker ever arrives at the dock for loading, much planning must be done and many tasks performed. The inexperienced PQAR's first failure is usually to not plan adequately for the loading. Planning must start when notification is received that a tanker will be arriving. As part of the notification, the PQAR is furnished information on the contract number that will cover the petroleum to be shipped, the quantity and type of fuel to be shipped, and the port from which the ship will be loaded.

Upon receipt of this information, there are several things the PQAR should do. He should first review all open contracts and make sure that they are up-to-date and that any changes to them have been posted. He should also check to determine the amounts of fuel that have been shipped under those contracts. His contract administration obligations can be fulfilled more easily if he is familiar with all current contracts.

The next thing the PQAR should do while awaiting the arrival of the tanker is to gather everything he is likely to need during the loading. This includes all the necessary forms, regulations, and instructions and items like tubes of fuel-finding and water-finding paste and valve seals. Having all of these things can often save valuable time and avoid delays. Never assume that the needed items will be available either at the refinery or aboard the ship.

The PQAR should establish contact with the tanker before it docks and find out what two previous cargoes the vessel transported. He should also determine the ship's position and estimated time of arrival and provide the ship's officers with information that might be useful in conditioning the ship to receive its cargo.

Once these things are done, the PQAR should confer with personnel of the refinery's petroleum operations section and with the refinery's product blender. Information about the tanker and its arrival time should be passed on to refinery personnel. A shore tank containing the fuel to be shipped can then be picked and the PQAR can physically inspect the tank to insure that the product is in good condition. Test samples can also be taken for laboratory testing. The blender will probably have laboratory test results that will help the PQAR determine early whether or not the product is within specification tolerances or if it is borderline. When the shore tank is picked and the sample taken, it may be personnally taken to the laboratory for testing, if necessary. This can often provide faster, more reliable test results.

There are still other tasks to perform before the tanker arrives. Sampling is the first step in the product testing process and a bad sample will produce undesirable test results. Testing is the primary ingredient in the QA process and a thorough knowledge of testing procedures is essential in verifying that fuel to be shipped meets contract specifications. Thereafter, the PQAR may require further tests of the product at various points during the loading process.

A note of caution—the PQAR should require additional testing only if he suspects a problem. Unnecessary testing wastes refinery time and money and can cause a strain in relationships with refinery personnel. A PQAR will sometimes order tests when he is not confident in his knowledge of product specification tolerances.

The PQAR must have an intimate knowledge of the petroleum testing techniques described in the American Society of Testing and Materials manuals. Most laboratory technicians with whom I worked neither spoke nor read English, and the manuals are not translated into any other language. These technicians learned testing procedures from more experienced laboratory personnel who sometimes took testing shortcuts which they felt did not alter test results.

With testing as the first step, measuring becomes the second critical step in the loading process. When the PQAR remembers that he alone is responsible for the quality and the quantity of the product to be loaded, then testing and measuring is ultimately important.

When the test results show the selected shore tank product meets specification tolerances, it's time for the measurement process to begin. Gaging is the method for computing the quantity of product in the tank. The PQAR is required to witness the opening and the closing gagings of the shore tank. The opening gaging is taken after the hoselines that will carry the product from the tank to the tanker have been washed with the product.

Strapping charts are used to calculate the tank volume and provide tables that convert the depth of the product in the tank to linear units of measure. I have gaged tanks and completed my computations only to find I was wrong because I used an old strapping chart for the tank I had gaged.

The PQAR must know the difference between gaging *innage*—the measure of product in the tank—and gaging *ullage*—the measure that a tank lacks being full. The differences cause confusion when strapping charts are used to calculate tank quantitites.

A sobering thought for the PQAR is the realization that the average tanker holds approximately 200,000 to 220,000 barrels of product. When multiplied by the October 1981 price of $1.30 per gallon for JP-4 fuel, then product cost alone ranges from $11 to $12 million. For example, a 2 percent error in the shipper's favor would cost the government $240,000 on a $12 million shipment—reason enough for accurate measuring.

When the tanker docks, the next step of the loading process begins. The PQAR should meet with the ship's captain or master and determine who has been delegated authority to perform the actual loading. The PQAR should work directly with the person in charge of the loading.

Together, the loadmaster and the PQAR should plan the cleaning and loading of the tanker. While the ship's crew is deballasting and cleaning the tanks, refinery personnel should be washing the line from the shore tank to the dock's loading risers. The PQAR should sample and test the line product during the washing until it meets contract specifications. After the line washing is complete, the PQAR must insure that the line is still full. An unfilled line will result in a gaging error later.

When the loadmaster notifies the PQAR that the tanker is ready to take on the product, a thorough inspection of the ship should be made to insure that tanks and lines are thoroughly clean and that manifold lines and the pump room are free of contaminants. Contamination of the product will result in loading delays or the shipment of off-specification product.

When satisfied that the ship is ready, the PQAR contacts the refinery's gager and they go together to take the opening gage of the shore tank and the product temperature in order to compute the temperature quantity conversion.

The readings could be taken more quickly from the refinery's computer readouts, but the PQAR must be cautious of relying on automated devices. A computer is not good at detecting various problems like open valves and product bleed-over that can occur between parallel lines

Once the preloading jobs are complete, the ship is ready to take on product. Loading problems and mistakes are similar to those of preloading, but they occur in different ways.

By carefully following instructions in the Petroleum Procurement Quality Assurance Manual, the PQAR can avoid procedural mistakes. The PQAR will sample and test the product during loading as he did in preloading, particularly if there is any in-line blending of product.

Fuel system icing inhibitor is frequently blended with the product as it flows through the line. Care must be taken to insure that the inhibitor is uniformly distributed throughout the ship's tanks according to specification. Injector pump malfunctions can occur and additive containers can empty, causing the product to fail to meet specifications.

If preloading and loading procedures are carefully checked, postloading should present few problems. Such is not always the case, however. for mistakes made earlier are sometimes not discovered until postloading checks are made. These, of course, are the most costly and time consuming to correct.

I recall one instance where a tanker had to be completely offloaded, recleaned, another shore tank selected, and the entire preloading process repeated because a bottom sediment and water sample was improperly taken from the tanker.

Not until the postloading did the PQAR notice that the bottom sampler was incorrectly taking the sample. When the sample was taken correctly and tested, the result clearly showed sediment and water content so high that the ship had to be emptied and reloaded. Had the error been discovered early enough, only a few hundred barrels instead of several thousand barrels would have had to be pumped off. Time loss would have been, perhaps, 4 or 5 hours rather than 20 or more hours. Consider demurrage costs that range from $600 to $1,200 per hour, depending on the particular vessel, and one can see the costliness of such errors.

There are also other administrative tasks to complete. The PQAR must be certain to document all time elements such as ship arrival and docking, beginning loading, all loading start and stop times, completed loaded, and ship sailing time. Demurrage charges are assessed to the responsible party according to these documented times. All other paperwork must be completed, and it is a good idea to have it checked by another inspector if possible. If errors are found, they can be corrected before the documents are forwarded for payment.

The PQAR's signature on the appropriate document authorizes and obligates the Defense Fuel Supply Center to pay for that cargo; thus adequate, accurate documentation is extremely important. Only careful planning and watchful loading will insure that a tanker leaves the dock bearing the specified quantity and quality of product the government is paying to receive. With petroleum prices what they are, the government cannot afford to get less than it pays for. **FL**

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Worldwide Petroleum Workshop

Over 180 military officers and DOD civilians met at Cameron Station on 18-20 May 1983 to discuss issues facing the Defense petroleum community.

The 1983 Worldwide Petroleum Workshop focused on current problems and issues associated with:

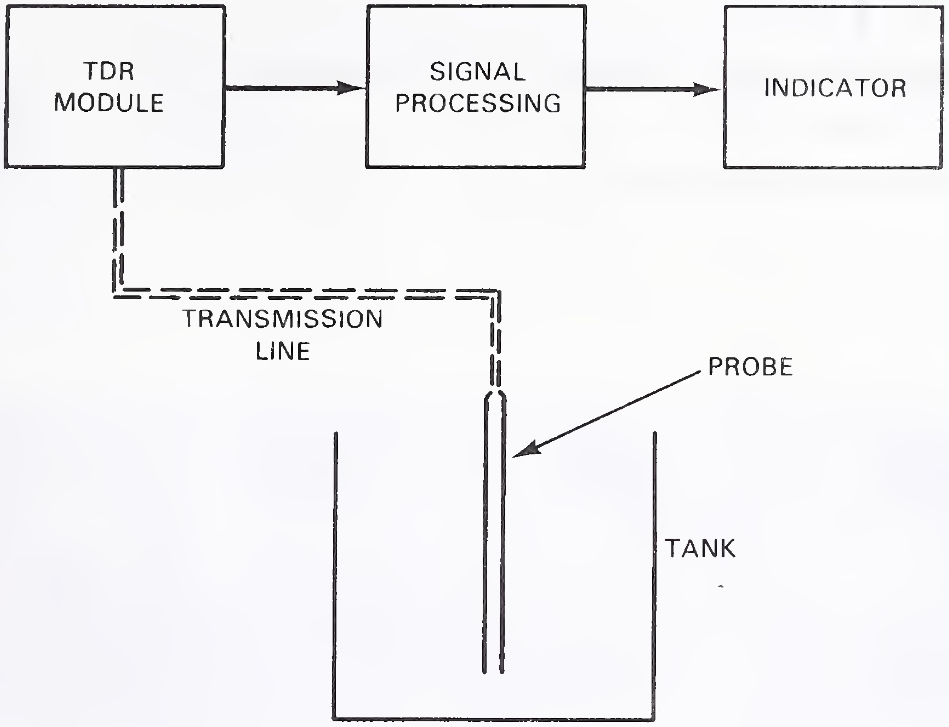
- The Inventory Management Plan processing schedule and the FY 84 Worldwide Inventory and Storage Plan data call.
- Erroneous Defense Fuels Automated Management System (DFAMS) data which is being submitted by the military services.
- Standardization of jet fuel (JP-4/JA-1) for Southwest Asia Operations Plan support.
- Impact and evaluation of the bulk war reserve study conducted by the Office of the Secretary of Defense (OASD) and the petroleum stockage policy study made by the Joint Chiefs of Staff.
- Worldwide planning for war reserve stock rotation.
- Submission guidelines for military construction projects by the commanders of the military services for DLA funding.
- Requirements for and timing of the injection of fuel additives and the filtering of bulk petroleum by DFSC within the wholesale distribution system.

As a result of the Workshop, 18 actions that are needed to enhance the readiness and capability of the DOD petroleum mission were identified. The recommended actions are now being pursued.

Highlights of the three-day Workshop included presentations by VADM E.A. Grinstead, Director, Defense Logistics Agency, Dr. Lawrence J. Korb, Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics [MRA&L]), and Mr. William J. Sharkey, Jr., Director of Energy and Transportation Policy (OASD MRA&L).

The format for this year's workshop differed significantly from the previous six Worldwide Petroleum Conferences. In the past, the meeting was primarily devoted to presentations on a wide variety of topics of interest. It was felt that this format no longer justified the expenditure of time and effort involved in sponsoring the event and that a workshop format would provide the problem-solving forum DFSC deemed essential to make the three-day event as beneficial as possible to the participants and the petroleum community as a whole. Response to the new format and the workshop itself has been overwhelmingly favorable as revealed by the workshop critiques. DFSC's Office of Planning and Management, which administered the workshop, credits much of the success to the fine support they received from DFSC's Directorate of Contracting and Production, Directorate of Supply Operations, Office of Telecommunications and Information Systems, Directorate of Facilities Management, and the Office of Administration. **FL**

New System Monitors Fuel and Water Levels In Storage Tanks



TDR TANK LEVEL INDICATOR

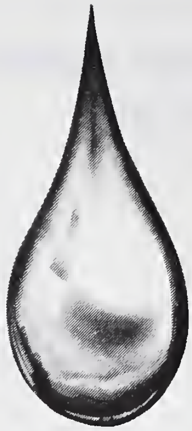
A new electromagnetic level indicating (EMLI) system using time domain reflectometry (TDR), being developed for fleet use at the David Taylor Naval Ship Research and Development Center (DTNSRDC), will provide a highly reliable method of monitoring fuel and water levels in storage tanks.

The final system configuration is modular electronics, which will be simple and automatic, requiring much less maintenance than tank level indicators currently used throughout the fleet. Investigations show that a system suitable for shipboard use can be designed with better than 0.25-inch resolution in the level measurement and can indicate the oil/seawater interface in ballasted tanks. While the acquisition cost is expected to be competitive with existing systems, the performance is projected to be better than devices presently used and is expected to provide improved reliability and maintainability.

TDR is the high frequency technique generally used to investigate the integrity of uniform cable runs. In this case, a cable connects the TDR electronics module to a specifically designed sensor that acts as a high frequency transmission line. The sensor consists of two conductors placed in close proximity that allow the tank contents to flow freely between them. The TDR electronic module pulses the sensor with a short duration electrical pulse and then times the returning pulses. Pulse reflections and propagation velocity changes are obtained at each fluid interface. The depths of the fuel oil and seawater can be calculated by signal processing of the TDR output. The EMLI system would thus consist of a rugged, corrosion-resistant sensor with no moving parts, a TDR electronics module, and a signal processing module to convert the TDR output into a suitable display and/or control signal.

Water in Fuel: Its Hazards and How to Prevent It

by Capt Joseph P. Finucane, USAF



Water is a life-giving element; however, if not properly isolated from jet fuel it can have the opposite effect. A constant threat to the quality of fuel and the performance of aircraft, water is not always easily detected and may continue to be present despite concerted prevention efforts.

There are three basic types of water found in fuel:

- *Dissolved water* is always present in jet fuel to some extent, with the amount depending upon ambient temperature and the fuel's chemical composition. For example, jet fuel with 10 percent aromatics at 54 degrees Fahrenheit can retain 54 parts per million of water in solution. Dissolved water cannot be seen nor can it be removed by equipment in the fuels handling systems but is precipitated or dropped out as free water as the fuel cools, a process that is more commonly referred to as "cold-soaking."
- *Entrained water* is held in suspension in the fuel, appearing as tiny droplets or a milky haze. This form of water is removed by extended settling of the fuel or by mechanical means such as the coalescing action or filter separators installed in fuels handling equipment.
- *Free water* is that which has separated from the jet fuel and settled into low points or sumps. It is removed by draining the sumps and low points.

There are a number of problems associated with allowing water to accumulate in fuel systems. Air Force jet fuel contains ethylene glycol monomethyl ether, better known as fuel system icing inhibitor (FSII), which effectively lowers the freeze point of water in the fuel to prevent icing problems. Since FSII blends with water, when the water settles out the additive is also removed. When this happens, protection from freezing of any water remaining in the fuel is lost, creating a very real possibility that small droplets of water will freeze and clog fuel screens, causing an engine flameout.

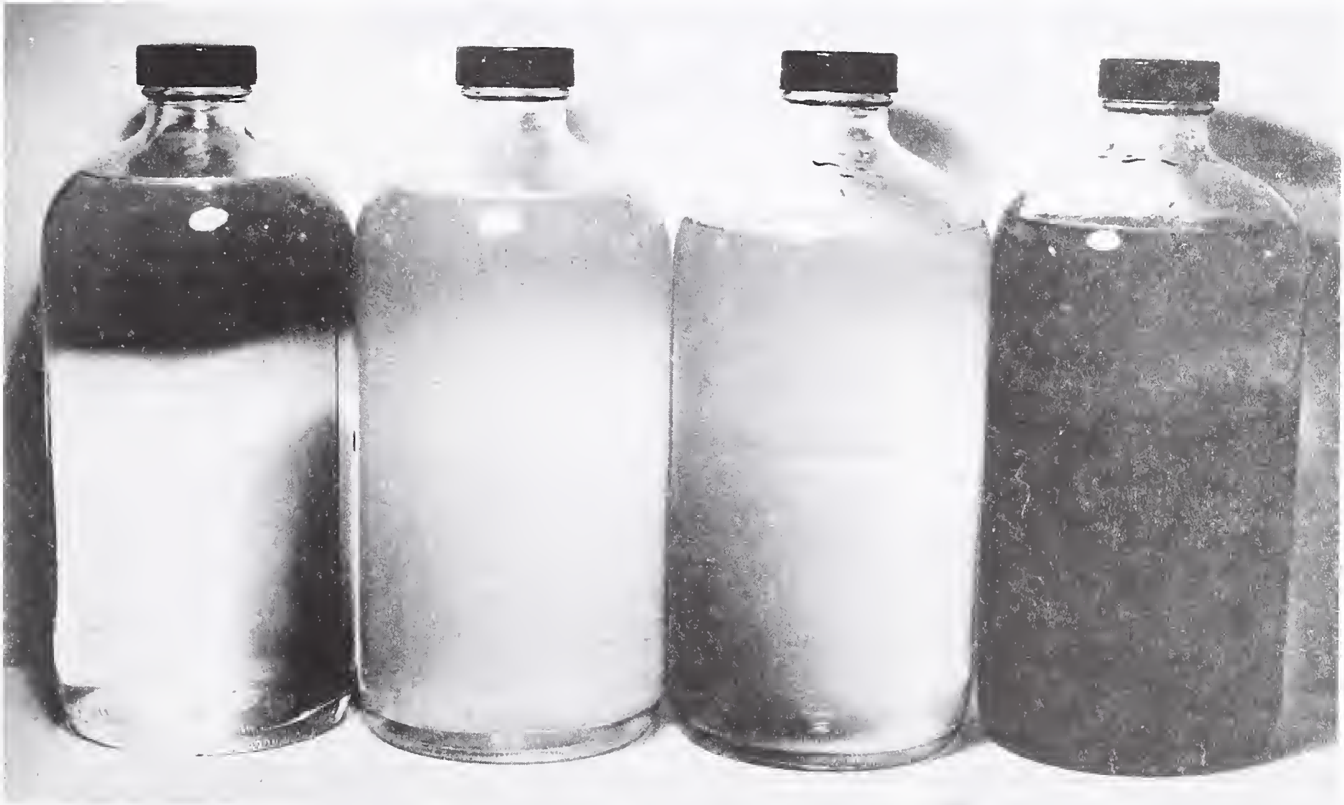
Microbiological growth of living organisms such as protozoa, fungus, and bacteria at the fuel/water interface also presents problems. (Such growth has a brown, black, or gray color and a stringy fibrous-like appearance.) The products of microbiological organisms and fungus hold rust and water in suspensions which cling to glass and metal surfaces and can cause sluggish fuel control operations, sticking flow dividers, and erroneous readings in fuel quantity systems. Although FSII restricts microbiological growth, the necessity of removing water from the aircraft fuel systems is not lessened.

Numerous measures are taken to remove water from fuel prior to reaching the aircraft, and specification tests are conducted to assure their effectiveness. Current JP-4 specifications call for a maximum limit of 4.0 mg/gallon of solid contaminants at the time of procurement to insure fuel cleanliness. Because the consumption rate of jet fuel per engine hour is normally much greater than a reciprocating engine carburetor, it is imperative that the quality of jet fuels and the condition of the systems used in handling them be closely controlled.

Upon receipt, fuel is tested and any water that is detected is removed. Prior to the fuel reaching the aircraft, fuels handling systems are equipped with a minumum of two filter separators to remove water. Periodic tests of the fuel reveal whether all filter separators are functioning properly. By removing all but dissolved water from the fuel, these steps insure that clean, dry fuel reaches the aircraft. While the aircraft is in flight and the temperature of the fuel is reduced, the dissolved water is separated from the fuel, collecting in the fuel tanks' sumps. It is mandatory that these sumps are later drained.

All personnel should be aware of the various types of water contamination. Fuels management personnel continually strive to deliver clean, dry jet fuel to the aircraft, but it becomes the responsibility of maintenance and operations personnel to insure the fuel remains clean and dry. Water, if allowed to accumulate, will create many serious and unnecessary problems. **FL**

CAPT JOSEPH P. FINUCANE, USAF is the Chief of the Energy Management Branch of Headquarters Eighth Air Force at Barksdale AFB, LA.



WATER DAMAGES—Water in jet fuel can be dangerous, so all personnel should know what to look for. Shown left to right are: (1) clean JP-4; (2) JP-4 with entrained water; (3) free water bottom and JP-4 with entrained water on top; and (4) JP-4 with water bottom containing biological contamination.

Photo by TSgt Daniel P. Getto, USAF

New Coal Liquefaction Process Promises Greater Efficiency

Hydrocarbon Research Inc. (HRI), which worked with the federal government to pioneer one of the first modern-day synthetic fuel concepts, has begun testing a new, more advanced coal-to-liquid process under a $4.3 million contract with the Department of Energy.

The process is one of a new family of synthetic fuel technologies that uses two vessels linked in series to convert coal into liquid fuels, instead of the more conventional, single vessel approach. The HRI concept, however, differs considerably from other techniques being developed by the Energy Department.

The firm, a subsidiary of the Dynalectron Corp. based in McLean, VA, has begun a two-year research project to test the advanced process at its experimental unit in Trenton, NJ.

The Energy Department recently turned its attention to the two-vessel approach as a way of improving the efficiency and economics of converting coal into synthetic oil. By separating the process into two steps, conditions inside each vessel can be tailored more precisely to the complex chemical reactions taking place. This approach could lower the temperatures and reduce the amount of expensive hydrogen needed to produce high-quality liquids from coal.

This emphasis on the two-vessel approach follows the successful testing of variations of the single-step concept at several federally co-sponsored pilot plants, one of which, in Catlettsburg, KY, employed the "H-Coal" liquefaction concept, originated by HRI in the mid-1960s.

The new approach is an outgrowth of the H-Coal process and will use several of its key features. For example, catalysts similar to those used in the Catlettsburg pilot plant will be added to speed the reaction. Also, the mixture of catalyst and coal will be kept "bubbling" in an oil made by the process. This method of mixing the material inside the liquefaction vessel is called an "ebullating bed" and was shown to be effective at the Catlettsburg plant.

On the other hand, the HRI approach will incorporate several features which distinguish it from other coal-to-liquid processes. One unique concept, for instance, will be the "close-coupling" of the two vessels.

Other two-stage liquefaction processes, such as one being tested by the Energy Department in an experimental unit in Alabama, separate the two vessels with a de-ashing step. This device removes coal ash and minerals from the dissolved coal before they can contaminate the catalyst in the second vessel. However, because this intermediate step operates at lower temperatures and pressures than the actual liquefaction steps, the liquid must be reheated and pressurized before passing into the second stage.

Close-coupling of the vessels permits operation to proceed with little change in temperature and pressure. Catalysts may be required in both stages, but if the two-vessel approach can significantly lower the temperatures needed to break coal apart, poisoning of the catalysts could be minimized and their lifetimes prolonged. Removing the ash by conventional methods downstream of the second vessel, instead of between stages, could also reduce the complexity of the liquefaction system.

Energy Department Officials believe that by developing two variations of the two-vessel concept—one linking the steps directly, the other employing an intermediate deashing step—future synthetic fuel developers will be able to compare advantages and choose from different technical approaches.

HRI is using an Illinois coal for the first operations in the 50 pound-per-day test unit at Trenton. After the first test runs are completed, another coal will be fed into the test unit under different operating and process conditions. In addition, the firm plans to investigate possible modification to their technology by identifying improved catalysts and methods of preparing the coal before it is liquified.

The project will be managed by the Energy Department's Pittsburgh (PA) Energy Technology Center, the federal government's lead center for coal liquefaction research. **FL**

Commercial Scale Shale Oil Jet Fuel Program Begins

Under a contract arranged by DFSC, Gary Energy Corporation will produce shale oil-derived jet fuel on a commercial scale. The Gary contract is the first such agreement to produce military jet fuel from shale oil on a large commercial basis.

Under the terms of the four-year contract, Gary Refining Company in Fruita, near Grand Junction, Colorado, will provide at market prices 308 million gallons of JP-4, refined solely from shale oil, for two western Air Force bases. The total value of the contract is estimated to be more than $300 million, with annual revenues in the first year expected to be approximately $70 million.

Gary expects to begin shipping the jet fuel to Hill Air Force Base, Utah, in January 1984, and to Mountain Home Air Force Base, Idaho, in March 1984. The fuel will enable the Air Force to conduct full-time product testing in its jet engines over the 4-year period.

Gary is installing at its Fruita refinery a 6,000 barrel per day hydrocracker that will expand the refinery's daily crude oil processing capacity from 13,500 to 17,000 barrels and its gasoline-making capacity from 4,000 barrels to nearly 6,000 barrels per day. With its new facilities, the refinery will be capable of fully converting a wide range of crude oil and heavier feedstocks into jet fuel, unleaded and regular gasoline, and diesel fuels. Union Oil of California will supply the Gary refinery with upgraded shale oil from Union's Parachute, Colorado, plant. Union Oil has proceeded with its project despite the shutdown of the Exxon/TOSCO Colony Project and other Western Colorado/Eastern Utah oil shale activities. Gary expects to begin taking deliveries of Union's shale oil production in September.

The hydrocracker unit will process both petroleum and shale oil-derived gas oils into a full range of transportation fuels, including jet fuel, gasoline, diesel, propane and butane. An integral hydrogen plant has been constructed to process natural gas into hydrogen for use in the hydrocracker unit. The hydrogen is required to change the physical properties of the feedstock during the hydrocracking process. In support of the hydrocracker operation, substantial raw material and finished product tankage has been built, as well as a new electrical substation for the facility's power system, a water cooling tower, fully automated finished product blending and loading facilities, and expanded laboratory facilities.

Additionally, a significant portion of the project and total cost has been directed toward protection of the refinery's environment. Three major components to the hydrocracker facilities are being installed to meet or exceed air and water quality regulations by processing hydrogen sulfide gas into a commercial grade sulfur. A sour water stripper unit will separate hydrogen sulfide from the water being used in the hydrocracking process and other refinery process units. An amine unit will also remove hydrogen sulfides from the refinery gases produced in the hydrocracker and other units within the refinery. A sulfur plant will then convert these hydrogen sulfides into saleable sulfur.

Gary also is currently evaluating the construction of a crude oil pipeline from Union's Parachute Creek oil shale plant of the Fruita refinery to handle the transportation of Union's material and other future projects' shale oil supply from that general area. **FL**

Air Force Tests Shale Jet Fuel

Tests are underway at the Aeronautical Systems Division's Aero Propulsion Laboratory at Wright-Patterson Air Force Base (AFB) to determine if Air Force jet aircraft can use fuel from shale oil. DFSC procures the shale-oil fuel for the Air Force.

Shale oil is one of the most abundant energy resources in the nation. According to Charles R. Lowe, chief of Logistics Management Division in the Directorate of Energy Management at Kelly AFB, Tex., the equivalent of more than 2 trillion barrels of oil are locked in the nation's vast shale oil reserves that are concentrated mostly in Utah, Wyoming, and Colorado.

A Pratt and Whitney TF30-P-3 engine—the power plant for some F-111 aircraft—is being used in the tests. The tests should reveal whether the fuel has an adverse effect on engine hot-section durability, performance and ability to operate.

Webster's New World Dictionary defines shale oil as "a dark mineral oil produced by the destructive distillation of bituminous shale or brown coal." Shale is "a kind of fine-grained, thinly bedded rock formed largely by the hardening of clay."

Before the fuel is tested in the engine, however, the JP-4 must meet rigid Air Force specifications. It is tested for conformance at two other Wright-Patterson laboratories—the Air Force Wright Aerospace Laboratory and the Energy Management Laboratory.

The test engine will undergo more than 400 hours of accelerated mission testing, the equivalent of about 1,000 hours of normal flight time. The engine is subjected to rapid acceleration to maximum power several times each hour. After the engine has been installed and checked out, the test is conducted automatically by computer, according to pre-programmed instructions.

Engine specialists from Tinker AFB, OK, will perform an in-depth inspection of the engine midway through testing. A second inspection will be done at the end of the accelerated mission test to determine if the engine hardware has been affected by the shale-derived fuel.

Tests will continue through mid-September, with final inspection being completed in late October.

An F-100 engine, which powers F-15 and F-16 aircraft, is being similarly tested at the contractor plant in West Palm Beach, FL. Final inspections are to be made in early September, according to program manager Royce Bradley.

After analyzing results of both tests, Pratt and Whitney and General Dynamics engineers will make recommendations on the suitability of using the fuel in the two engines.

"We don't anticipate any significant differences between the use of conventional petroleum-derived JP-4 and the shale-derived fuel," Bradley said.

After flight tests are made at the Air Force Flight Test Center at Edwards AFB, CA, the next step will be to use the fuel on an operational basis. The first operational use is planned for F-16s in January of 1984 at Hill AFB, Utah, later followed by use of the fuel in F-111s at Mountain Home AFB, Idaho.

"This will lead to a decision on using the shale-derived fuel interchangeably with conventional JP-4," the program manager said.

Lowe said shale is being used to produce heating as well as jet fuel. "Since the Air Force and the nation depend on foreign countries for much of its petroleum, the use of these vast shale oil deposits could be a major step in changing future energy sources," said the fuels manager. **FL**

As Good As New . . . Maybe Better

by Bill Linville
U.S. Department of Energy

More than 340 million gallons of used motor oil a year could be collected and re-refined into usable lubricating oil, according to a recent DOE report.

The 128-page publication, "Analysis of Potential Used Oil Recovery From Individuals," reveals the findings of a nationwide survey of 4,805 households to determine what happens to used motor oil and examines the feasibility of collecting it for re-refining.

Bartlesville Energy Technology Center (BETC), which sponsored the survey by Market Fact, Inc. of Chicago, reports that processes developed in recent years can produce re-refined motor oils that, when compared to virgin motor oils, perform as well or better and cost less. Furthermore, these re-refined oils meet the highest grade standards after reformulation, and the re-refining process produces little or no pollution.

But the use of re-refined oil hasn't caught on yet. BETC says the reason is lack of public trust in the product and lack of a workable used oil collection system, especially for individuals who change their own oil.

Fifty-five percent of the car owners surveyed changed their own oil at least part of the time. Thirty-nine percent of them pour the used oil on the ground, 21 percent put it into a container and then into the garbage, and only 14 percent turn it in for recycling. Smaller percentages of those surveyed burn the oil at home or use it in machinery.

The survey found that most persons who change their own oil do not believe that recycled motor oil is as good for their cars as new motor oil.

BETC research has shown that re-refined oil can be as good as new. Dennis W. Brinkman, BETC project manager for processing, says the unstable materials in new oils, which can react during use and become contaminants in used oil, are removed as sludge during high-quality re-refining processes. He adds that extensive testing by DOE and various labs has confirmed the potential equivalence of re-refined oil with virgin lubricants.

Survey respondents indicated incentive payments of up to 15 cents a quart would not encourage the return of used motor oil for recycling.

"No economic incentives seem to work," says Brinkman. "It's probably going to take some community organization or fund-raising group efforts, plus a feeling on the part of those who change their oil that there is a need to conserve an important resource, before people will be willing to recycle their used oil rather than treat this valuable resource as waste." **FL**

Uniquely Qualified Teacher Passes on His Skills

by Denise M. Gower

A group of students who recently completed a course held at Cameron Station had to agree—the teacher was an expert.

Tim Troutman, a deaf employee of DFSC, had led his class through 20 weeks of an introductory sign language course and now he was sending his brood off into the world. He stood before a cake which he had baked and decorated for them in recognition of their accomplishments and signed, "I am glad that you have taken this course not only to communicate with the deaf, but also to open the barriers to communication. I am very proud of all of you."

And if truth be told, the class was just as proud of him. Originally, Troutman had assisted Effie Bell, a DLA employee who had developed and begun teaching the course in 1976, but when Bell learned she would have to be on TDY for several weeks, she asked Troutman to take over for her. Hesitantly, he said, yes. "I wasn't sure I could do it," he said later.

He need not have worried. By the time Bell returned, he and the class had developed such a rapport, that the students asked Bell to allow him to continue.

With that vote of confidence, Troutman set about planning lessons, developing exercises, and drilling his students in the hundreds of signs they were expected to learn. Under his tutelage, the class learned quickly and well. As the students' sign language abilities increased so too did Troutman's confidence. "The students helped me as well," he said. "Before, I had not fully accepted my hearing loss; I was a little embarrassed by it. But by the students' acceptance of me, I learned that people are people."

Having heard about his successes in the classroom, several of Troutman's co-workers asked him to teach them sign language and he plans to teach another introductory course for DLA employees at Cameron Station.

DLA has offered the introductory sign course since 1976, providing books and allowing students to supplement two 30-minute lunch periods a week with 30-minute excused absences. Troutman is the first deaf employee to independently teach the course. He hopes that his efforts will lead to increased communication between the deaf and the hearing, believing that better understanding between the two groups will lead to enhanced career opportunities for the deaf.

As a traffic management specialist for DFSC's directorate of supply operations, Troutman reviews and analyzes a variety of transportation documents. He has also been employed as a stock clerk and an electrical engineering assistant. A native of Johnson City, Tenn., he moved to the Washington, D.C. area to attend the Kendall School for the Deaf. He later received a B.A. degree from Gallaudet College. **FL**

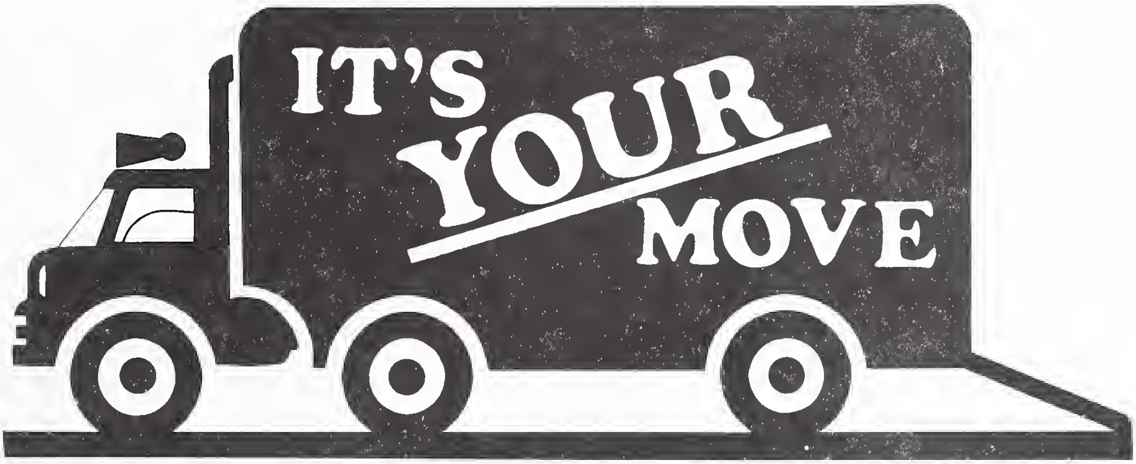
Civilian PCS Benefits Improved

Federal civilian employees transferring at the convenience of the government will find some new and some expanded benefits among recent changes to federal travel regulations.

Following is a summary of some of these changes, published in Volume II of the Joint Travel Regulations:

- The time limit for beginning travel and transportation has been extended to 2 years from the effective date of the employee's transfer or appointment. Certain exceptions, however, are permitted to the 2-year limit.
- An employee and spouse will be paid for separate house-hunting trips, provided the cost is limited to what it would cost them to make one round-trip together. The maximum length of a house-hunting trip is extended from 6 to 10 days.
- Reimbursement for taxi fares will be allowed; however, the approving official may restrict reimbursement for use of taxis when airport limousine service or courtesy transportation is available.
- The 11,000-pound maximum statutory weight allowance for household goods shipment has been extended to all employees, regardless of family status. The household goods temporary storage period has been increased from 60 to 90 days. Federal agencies now have the authority to allow an additional 90 days under certain circumstances.
- Pay of temporary quarters subsistence expenses for 30 days can be made when the temporary quarters become the employee's permanent residence. Payment will be made only if the employer can establish the original intent was to occupy the quarters temporarily.
- Mileage reimbursement rates for PCS travel were increased to reflect current airline fares. The new mileage rates are: employee only, 15 cents; employee plus one family member, 17 cents; employee plus two family members, 19 cents; and employee with three or more family members, 20 cents.
- Reimbursement may be made for forfeiture losses on medical, dental and food locker contracts that are not transferable; and contracts for private institutional care, such as that provided for handicapped or invalid dependents only, which are not transferable or refundable.
- Certain items that previously were not shipped as household goods by the government may now be shipped. Examples are snowmobiles, motorcycles, mopeds, and golfcarts.
- The miscellaneous expense flat-rate allowance has been increased from $100 to $350 for employees without dependents and from $200 to $700 for an employee with dependents.

For further information, details and exceptions to these changes, check with the transportation office at your installation. **FL**



Fuel Line Gleanings

DFSC has nominated Gerald Snodgrass and Stanley Zaucha for the DLA Quality Assurance Representative (QAR) of the Year Awards.

Snodgrass is a petroleum QAR at the Defense Fuel Quality Assurance Residency (DFQAR) High Wycombe, U.K. He was previously stationed at DFQAR Naples, Italy. In both positions, he has performed as a nonresident QAR covering over thirteen refineries, fuel terminals, and Defense Fuel Support Points.

Zaucha is the resident QAR at DFQAR Hawaii and as such has directed the procurement quality assurance program for petroleum products throughout the state.

Headquarters, Air Force Logistics Command (AFCL), is realigning in order to streamline its support of Air Force weapons systems.

The main elements of the reorganization will be the Planning/Policy Staff and the Logistics Operations Center. About 1,800 people from current chief of staff offices and some deputy chief of staff offices will become the Planning/Policy staff. The new Logistics Operations Center, with about 600 people, will be responsible for day-to-day operations.

In addition to changes at the headquarters, the Cataloging and Standardization Office in Battle Creek, MI, will become a full-fledged center, called the AFLC Cataloging and Standardization Center.

American Petroleum Institute (API) Publication 2519, *Evaporation Loss from Internal Floating Roof Tanks,* third edition, is now available. The publication contains an improved method for estimating total evaporation losses and/or the equivalent atmospheric hydrocarbon emissions from freely vented internal floating roof tanks containing multicomponent hydrocarbon mixtures such as petrochemicals. For ordering information contact: J. K. Walters, API, Measurement Coordination Department, 210 L. St., N.W., Washington, D.C. 20037.

A self-paced extension course on contractor performance measurement (CPM) is now available from the Defense Systems Management College.

The course consists of 11 modules that cover the methods used in evaluating a contractor's progress in meeting the terms of Defense acquisition contracts. Students who successfully complete the course will receive a certificate of completion from the college.

Military officers and equivalent-grade civilian personnel may take the course without charge; there is a $50 fee for industry employees and part-time government personnel.

Additional information about the course may be obtained by writing to Registrar, CPM Extension Course, Defense Systems Management College, Fort Belvoir, VA. 22060, or calling AUTOVON 354-3120 or commercial (703) 664-3120. (Army Logistician)

Military Family Newsletter Available

A four-page newsletter, which the Armed Services YMCA developed specifically for military families, is getting a good response from military families across the nation. This resource is being provided to recruiters' families of each service including the Coast Guard.

Called *Military Family Life,* the resource addresses the unique challenges that face military families. It is aimed at helping families become self-sufficient and at enhancing pride in military living.

The Armed Services YMCA is making additional copies of this newsletter available at attractive bulk rates for use in conjunction with other family programs. They lend themselves to commanders' familygram letters, wives' clubs, ombudsmen and outreach programs.

For information, write: Executive Director, Armed Services Dept., YMCA, 101 N. Wacker Dr., Chicago IL 60606. A sample copy and bulk rates will be provided.

EIA Assesses Petroleum Resources of the North Sea

Cumulative production of crude oil from the North Sea was 3.6 billion barrels, as of January 1, 1982, according to a report released by the Energy Information Administration (EIA).

Citing the report, J. Erich Evered, EIA Administrator, said that there is an estimated 25.5 billion barrels of recoverable crude oil remaining in the known fields in the North Sea.

The report is the fifth in EIA's Foreign Energy Supply Assessment Program (FESAP) series. Evered said that the FESAP Program is an important attempt to provide petroleum resource assessments which are essential in determining the adequacy of future petroleum supplies in the world market.

The report contains significant data related to oil supply and production from the North Sea areas bordered by the United Kingdom, Norway, The Netherlands, Denmark, West Germany, Belgium, and France.

The study makes these other key points:

- As of January 1, 1982, there were at least 242 developed and undeveloped oil fields in the North Sea that originally contained about 96 billion barrels of oil in place and had an estimated 25.5 billion barrels of oil remaining to be recovered.
- The cumulative production of 3.6 billion barrels, brought the total estimated ultimate oil recovery to 29.1 billion barrels and the recovery efficiency to 30.5 percent of the original oil in place.
- An estimated 2.0 million barrels of crude oil per day of additional producing capacity could be developed from the northern North Sea basin.
- Output from the northern North Sea in 1981 was about 2.3 million barrels of crude oil per day which is about 4.3 percent of the world total.
- From both known and undiscovered oil deposits, production could be maintained to the year 2013 at a constant rate of 2.5 million barrels of oil per day; at 3.25 million barrels of oil per day, to the year 2004; and at 4 million barrels of oil per day, to the year 1998.

Copies of *The Petroleum Resources of the North Sea* are available from the U.S. Government Printing Office for $5.50 per copy, GPO Stock Number 061-003-00300-1. Copies are also available through the National Energy Information Center, Room 1F-048 Forrestal Building, Washington, D.C., telephone 202/252-8800. **FL**

New Theory Proposed for Formation of Coal

Argonne National Laboratory researchers claim they may have discovered how coal is formed, a finding which could lead to the development of cleaner and more efficient coal-burning technologies.

The discovery, which challenges the traditional theory of how coal is formed, is part of an Argonne study to determine the chemistry of coal. "We have made simple coals by duplicating conditions that are known to occur in nature," said Randall Winans, head of the Argonne group studying coal.

Scientists had theorized that coal was formed by the weight of rock and clay on top of humus, material formed by dead plants. Scientists had been able to make artificial coal by heating humus to about 750 degrees. The theory was never fully accepted, however, because the temperatures required to make coal from humus are rarely found in geological deposits.

Now, Argonne scientists may have learned how coal was formed at 300 degrees, a much more common temperature in geological deposits. The key, the scientists found, was lignin, a substance which holds plant cells together and is used in a range of products, from plastics and rubber to cosmetics and vanilla flavoring. In the presence of certain clays, the scientists were able to convert lignin into coal by heating it to about 300 degrees.

Winans explained that the research will help scientists to determine the chemical properties of coal, which, in turn, may help to devise better ways of utilizing coal. **FL**

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February

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Black History Month

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